REMARKS

Please reconsider the application in view of the above amendments and the following remarks. Applicant thanks the Examiner for carefully considering this application.

Disposition of Claims

Claims 1, 4-5 and 7-8 are pending in this application. Claim 1 is independent. The remaining claims depend directly from claim 1.

Claim Amendments

Claim 1 was amended by this reply to clarify the thrusting and heating steps recited. No new matter has been added.

Rejection(s) under 35 U.S.C. § 103

Claims 1, 4, 7, and 8

Claims 1, 4, 7, and 8 are rejected under 35 U.S.C. § 103(a) as being obvious over JP 09330947 ("JP '947") in view of JP 62004769 ("JP '769") and JP 56018643 ("JP '643"). To the extent this rejection still applies to claim 1 as amended, this rejection is respectfully traversed.

Independent claim 1 of the present application recites a method for producing an electrical device made up by a first object for bonding including a first electrode and a second object for bonding including a second electrode to be connected to said first electrode, by bonding said first object for bonding and said second object for bonding to each other, comprising the steps of:

- arranging an adhesive, mainly containing a thermosetting resin and a silane coupling agent as a first curing agent, at least on said first electrode, to form an adhesive layer, wherein electrically conductive particles are added to said adhesive from the outset;
- arranging a second curing agent, reacted with said first curing agent by heating to polymerize said thermosetting resin, at least on said second electrode, to form a curing agent layer, said second curing agent being mainly composed of an aluminum chelate and does not include an epoxy resin;
- positioning said first and second electrodes in register with each other;
- tightly contacting said adhesive layer on said first object for bonding with the curing agent layer on said second object for bonding;
- thrusting and heating said first and second objects against each other to soften said adhesive layer and mix said first and second curing agents and put said electrically conductive particles between said first and second electrodes, and
- further thrusting and heating said first and second objects against each other to develop a cation by reaction of said silane coupling agent as a main component of said first curing agent and said aluminum chelate as a main component of the second curing agent to allow said thermosetting resin to be cationically polymerized.

Thus, according to claim 1, the first curing agent mainly composed of a thermoset resin and a silane coupling agent and the second curing agent mainly composed of an aluminum chelate (and without a thermoset resin) are arranged on separate objects for subsequent bonding. Therefore, the silane coupling agent and the aluminum chelate do not react and generate cations until the adhesive layer is softened and the first and second objects are thrust together and heated. Because of this separation, cationic polymerization of the thermosetting resin does not

occur until the objects are brought together and heated, thereby maintaining long shelf life and high adhesion intensity.

JP '947 discloses a method of producing an electrical device comprising arranging an adhesive layer containing a curable resin and electrically conductive particles (added to the adhesive at the outset) on a first electrode of a first object, arranging an adhesive layer on a second electrode of a second object, positioning the first and second electrodes in register with each other, and with the first and second object facing each other, tightly connecting the adhesive layer on the first object to the adhesive layer on the second object, thrusting the first and second objects against each other to interconnect the first and second electrodes via the electrically conductive particles, and allowing the curable resin to be polymerized by heating.

The method taught in JP '947 (use of adhesive layers on both objects to be joined) allows for adhesive method to be used in bonding a semiconductor device and a substrate, even with changes in the electrode height (without short circuiting). *See* [0003], [0005]-[0006], and [0018]. Other than the use of electrically conductive particles and a curable resin, there is no discussion or suggestion in JP '947 of the types of components used on the first and second layers, much less whether the adhesive components in the first and second adhesive layers are the same or different. In any event, JP '947 seems to use epoxy-containing adhesives on both objects. Specifically, JP '947 fails to teach that the second adhesive layer does not include an epoxy resin, and that thrusting and heating is used to put the conductive particles between the electrodes and further thrusting and heating is used to generate cations to catalyze the polymerization of the thermoset resins.

Furthermore, according to the description in paragraph [0005] of JP '947, JP '947 the intent of its method to simplify the manufacturing process and reduce costs, particularly for bonding a semiconductor device and substrate where the electrode height may vary. Thus, not only is the actual process of JP '947 different from the present application, but also for a different purpose.

The Examiner relies on JP '769 and JP '643 as teaching the claimed arrangement of curable adhesive. Specifically, the Examiner asserts that it would have been obvious to use, as the two adhesive layers arranged on the first and second electrodes as taught in JP '947, the two-pack adhesive of JP '643, as two layers on the first and second objects shown by JP '769 so that the adhesive is cured between the two objects when desired. However, Applicant respectfully submits that the combination of these three references does not necessarily result in the claimed method as asserted by the Examiner. Further, Applicant respectfully submits that neither JP '769 nor JP '643 shows or suggests the claim limitations missing in JP '947, e.g., that the second adhesive layer does not include an epoxy resinand and that thrusting and heating is used to put the conductive particles between the electrodes and further thrusting and heating is used to generate cations to catalyze the polymerization of the thermoset resins.

JP '769 discloses forming an adhesive layer as follows. Previously, the base resin of a two-pack curable adhesive is applied to an adherent surface of one substrate and a curing agent is applied to an adherent surface of the other substrate. When the adherent surfaces of the two planar curable substrates are brought into contact with each other, the base resin and the curing agent gradually diffuse to the other layer to form one layer through the contact interface, and the curing reaction starts.

In contrast, according to the present invention, if an adhesive layer on the first object and a curing agent layer on the second object are simply brought into contact, the curing reaction does not start. Rather, when the first and second objects are thrust together and heated, the adhesive layer softens and the first curing agent and the second curing agent are mixed. Hereby, the electrically conductive particles can efficiently diffuse in the adhesive layer so that the electrically conductive particles are distributed between the first and second electrodes to efficiently conduct electricity. As the thrusting and heating are continued, the reaction of the silane coupling agent and the aluminum chelate starts. The reaction starts in the entire adhesive layer, not simply at an adhesive interface, and the adhesive layer is cured after the electrically conductive particles are distributed between the first and second electrodes.

As shown in figures 9 and 10 of the present application, electrically conductive particles are evenly distributed in the adhesive layer after the first and second curing agents were mixed. Then, after the first and second curing agents are sufficiently mixed, the cationic polymerization is started. As a result, a uniform and high adhesive strength is realized.

However, in the method described in JP '769, if curing starts at the contact interface without sufficient mixing, the adhesive layer might be cured before the conductive particles are put between the electrodes. This insufficient mixing and movement of the conductive particles may result in a poor connection between the electrodes such that high connection reliability cannot be realized.

In contract, according to the present application, the adhesive layer and the layer of the second curing agent are mixed sufficiently, the first and second electrodes are connected via the electrically conductive particles, and subsequently, curing starts. Therefore, in

accordance with the present invention, it is possible to realize high connection reliability in anisotropic conductive connection.

Further, according to the present invention, because the thermoset resin is provided only with the first curing agent on the first electrode and is not provided with the second curing agent on the second electrode, the contact interface such as that in JP '769 does not form when the adhesive layer is softened and the first and second curing agents are mixed by thrusting and heating. Accordingly, the first and second curing agents are mixed sufficiently and the above-described advantages are realized.

In JP '643, two-pack adhesive is generally taught. In this two-pack adhesive according to JP '643, a solution of first components containing an organosilicic compound in an epoxy resin and a solution of second components containing an aluminum compound in an epoxy resin are preserved separately. The first and second solutions are then mixed at the time of use to react the silanol and aluminum chelate, which polymerizes the epoxy resin. However, JP '643 only discloses a general cationic curing system, and has no suggestion of specifics recited in claim 1. Particularly, the aluminum compound (the equivalent of the second curing agent) in JP '643 is mixed in an epoxy resin matrix, which would alter the mixing dynamics and the curing reaction.

However, the inventors of the present invention have unexpectedly found that by generating (from silanes and aluminum chelates) the cations *in situ* when needed, using the components recited in claim 1, it becomes possible to polymerize the resins at significantly lower temperatures and the products have markedly better adhesive strength (as assessed by the peel-off strength; see Table 1 reproduced below).

TABLE 1

Results of Peel-Off Strength Test

	Ex. 1	Ex. 2	Ex. 3	Ex. 4	Comp. Ex. 1	Comp. Ex. 2
Peel-off Strength (N/cm)	11.5	11.8	13.2	13.4	1.3	1.3

As shown in examples 1-4 of the present application, the cured adhesive possesses high peel strength due to the separation of the first and second curing agents on the objects for bonding, whereas such high peel strength does not result in comparative examples 1 and 2, which combined the first and second curing agents in the adhesive layer, is low so as not to be able to bear practical use.

Further, according to the present application, by generating cations by reaction of the silane coupling agent with the aluminum chelate (as the main component of the second curing agent and in the absence of an epoxy resin), the thermosetting resin is cationically polymerized at a lower temperature and for a shorter time than with a conventional adhesive.

None of JP '947, JP '769, or JP '643 shows or suggests such all limitations of the amended claim 1. Therefore, claim 1 is patentable over JP '947, in view of JP '769, and further in view of JP '643. Dependent claims should also be patentable for at least the same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

Claim 5

Claim 5 is rejected under 35 U.S.C. § 103(a) as being obvious over JP '947, JP '643, and JP '769, as applied to claims 1, 4, 7, and 8 above, and further in view of JP 09067427 ("JP '427"). Claim 1, from which claim 5 depends, has been amended. To the extent that this reject may still apply to claim 5, this rejection is respectfully traversed.

As noted above, JP '947, JP '769, and JP '643 do not show or suggest separation and subsequent reaction between a silane coupling agent (dispersed in a thermosetting resin) and an aluminum chelate (in the absence of an epoxy resin) on two objects to generate cations and trigger polymerization of a resin upon thrusting and heating of the two objects, as required by claim 1.

JP '427 teaches a silane coupling agent modified phenol resin, obtained by reacting a silane coupling agent with a phenol resin. However, JP '427 does not teach or suggest that which is missing in JP '947, JP '769, and JP '643.

Therefore, JP '947, JP '769, JP '643, and JP '427, whether considered separately or in combination, fail to teach or suggest every limitation of the amended claim 1. Thus, claim 5, which depends from claim 1, should be patentable over JP '947, JP '769, JP '643, and JP 427. Accordingly, withdrawal of this rejection is respectfully requested.

Claims 1, 5, 7, and 8

Claims 1, 5, 7, and 8 are rejected under 35 U.S.C. § 103(a) as being obvious over U.S. Patent Publication No. 2002/0151627 to Matsushima in view of JP 07082533 ("JP '533"). Claim 4 is rejected under 35 U.S.C. § 103(a) to Matsushima and JP '533, as applied to claim 1, and further in view of either U.S. Patent No. 4,772,672 to Isozaki or JP 07011152.

Applicant notes that the claims are supported by the present application's foreign priority documents, JP 2002-044232, filed on February 21, 2002, a certified copy of which has been previously filed, and an English translation of which is submitted herewith. Accordingly, the present application has a perfected priority date of February 21, 2002.

Matsushima has a publication date of October 17, 2002, which is after the present application's priority date, February 21, 2002. Thus, Matsushima can be a prior art reference only under 35 U.S.C. § 102(e).

Applicant respectfully notes that Matsushima and the present application, at the time the invention was made, were owned by Sony Chemicals Corporation, now named Sony Chemical and Information Device Corporation. The assignment (and change of name) for the present application are recorded at Reel 016041, Frame 0799 and Reel 018550, Frame 0258, and the assignment (and change of name) for Matsushima are recorded at Reel 021794, Frame 0292.

Therefore, under 35 U.S.C. § 103(c), Matsushima cannot be used as a prior art reference for a § 103 rejection. Accordingly, withdrawal of this rejection is respectfully requested.

Conclusion

Applicant believes this reply is fully responsive to all outstanding issues and places this application in condition for allowance. If this belief is incorrect, or other issues arise, the Examiner is encouraged to contact the undersigned or his associates at the telephone number listed below. Please apply any charges not covered, or any credits, to Deposit Account 50-0591 (Reference Number 17155/003001).

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Respectfully submitted,

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